OLIMEXINO-85

Arduino-compatible board

USER'S MANUAL

Revision B, January 2014
Designed by OLIMEX Ltd, 2013

All boards produced by Olimex LTD are ROHS compliant

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The software developed by Olimex LTD is released under GPL. The software developed for Little Wire and Digispark is released under their respective licenses.

It is possible that the pictures in this manual differ from the latest revision of the board.

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THERE IS NO WARRANTY FOR THE DESIGN MATERIALS AND THE COMPONENTS USED TO CREATE OLIMEXINO-85. THEY ARE CONSIDERED SUITABLE ONLY FOR OLIMEXINO-85.

THE DESIGN OF OLIMEXINO-85 IS BASED HEAVILY ON THE LITTLE WIRE'S DESIGN BY IHSAN KEHRIBAR AND USES DIGISTUMP'S DIGISPARK SOFTWARE. OLIMEXINO-85 WOULD NOT HAVE BEEN POSSIBLE WITHOUT THE EXISTENCE OF BOTH LITTLE WIRE AND DIGISPARK PROJECTS.

Table of Contents

CHAPTER 1: OVERVIEW

1. Introduction to the chapter

Thank you for choosing the OLIMEXINO-85 from Olimex! This document provides a user's guide for OLIMEXINO-85. As an overview, this chapter gives the scope of this document and lists the board's features. The document's organization is then detailed.

The OLIMEXINO-85 development board enables code development of applications running on the AVR ATtiny85 microcontroller, manufactured by Atmel Corporation, USA.

OLIMEXINO-85 is an open-source, open-hardware project and all documentation is available to the customer.

1.1 Features

The board has the following set of features (note about the difference between the two versions of the board):

- ATtiny85-PU microcontroller with pre-loaded "micronucleus tiny85" bootloader
- Tested and working with Digisparks's Arduino distribution
- Breadbord compatible via the header
- Two LEDs - power and status
- Reset button
- All components already soldered (unlike the DIY version)
- Easy-to-replace components in case of fault
- Open-hardware board, board schematics and layout available for Eagle
- Open-software board, thanks to the Digispark's community effort and the Little Wire project
- Dimensions - (1.275 x 0.800)" ~ (32 x 20)mm

1.2 Target market and purpose of the board

All boards in the OLIMEXINO family feature a built-in bootloader (for serial programming without special tools). The main usage of the boards is software embedded development without the urge of understanding perfectly the hardware using Arduino or Arduino-derived IDE.

The strong points of the OLIMEXINO-85 are: the tiny form factor, the small consumption, the fact that you can program it without special programmer via mini USB cable!

Customers have full access to the technical documentation of the board. The software is released under General Purpose License and the board is considered open-hardware – all schematics and board design files are available to the customer under the Creative Commons Attribution-ShareAlike 3.0 Unported License.

1.3 Board variants

There are two major board variants named: OLIMEXINO-85-ASM and OLIMEXINO-85-KIT. The difference between the two versions is that the KIT one comes with no components soldered. The already soldered version is called ASM (short from "assembled").

It is possible that the board or the kit you own has either mini USB connector or USB type B, connector. This might alter the recommended cable. Initially, we used to mount mini USB connector since we believed most people already have some sort of mini USB cable which would reduce the end cost for the customer. However, the mini USB was much harder to place and solder than the rest of the components and many customers found it frustrating. We decided to place USB type B for newer revisions which is much easier to solder.

This document is suitable for both boards. However, for more precise soldering instructions (regarding the KIT variant) it is recommended to refer to the soldering guide, which is a stand-alone document and might be downloaded from the KIT's web page.

1.4 Board version used in the manual

Hardware revision A boards and resources were used while writing this document. It is possible that they are outdated so it is always recommended to refer to the stand-alone schematics available at our web-site.

The hardware revision of your OLIMEXINO-85 is printed on the top under the name of the board.

1.5 Organization

Each section in this document covers a separate topic, organized as follows:
  – Chapter 1 is an overview of the board usage and features
  – Chapter 2 provides a guide for quickly setting up the board and software notes
  – Chapter 3 outlines the main parts of the OLIMEXINO-85
  – Chapter 4 describes the component that is the heart of the board – the ATtiny85 and explains the needed connections for external programming via a compatible tool
  – Chapter 5 covers the connector pinout, peripherals and jumper description
  – Chapter 6 provides the schematics and the dimensions of the board
  – Chapter 7 contains the revision history, useful links and support information

CHAPTER 2: SETTING UP THE OLIMEXINO-85 BOARD

2. Introduction to the chapter

This section helps you set up the OLIMEXINO-85 development board for the first time. Please consider first the electrostatic warning to avoid damaging the board, then discover the hardware and software required to operate the board.

The procedure to power up the board is given, and a description of the default board behavior is detailed.

2.1 Electrostatic warning

OLIMEXINO-85 is shipped in a protective anti-static package. The board must not be exposed to high electrostatic potentials. A grounding strap or similar protective device should be worn when handling the board. Avoid touching the component pins or any other metallic element.

2.2 Requirements

In order to set up the OLIMEXINO-85 optimally one or more additional items may be used. They might be generally placed in two categories:

Required - items that are needed in order to achieve minimum functionality;
Recommended – items that are good to have in order to be able to interact with the most important of the features of the board;

Required items:

- **USB type A to USB mini cable** – to connect to a personal computer; used for powering the board and uploading new programs

Recommended items:

- **Breadboard** - for solderless access to GPIO and VCC/GND pins via jumper wires
- **Jumper wires** – wires for use
- **AVR-compatible programmer** – in case you delete or overwrite the bootloader program
- **External power supply unit** – 3.6V DC for stand-alone power (no mini USB)

Some of the above-suggested items can be purchased from Olimex, for instance:

USB-A-B-CABLE or USB-MINI-CABLE – standard cables depending on the connector
BREADBOARD-1 – with 0.1' step that allows easy plugging of the OLIMEXINO-85
JUMPER-WIRES – wires with male and/or female connectors for use with breadboards
AVR-ISP500 – compatible programmer with 6-pin and 10-pin ICSP connectors
AVR-ISP-MK2 – compatible programmer with 10-pin ICSP connector

2.3 Powering the board

The usual way to power OLIMEXINO-85 would be to connect it to your computer via USB cable. The OLIMEXINO-85 has either a USB type B or mini USB connector (based on revision, older revisions have the smaller one) mounted so make sure your cable is suitable.

There are two ways of powering OLIMEXINO-85 - either using the default USB powering or by supplying 2.7V to 5V to the GND and the VCC pins of the header.

## 2.4 Connecting to the Digispark IDE

The ATtiny85 of the OLIMEXINO-85 is pre-programmed with a bootloader that allows it to act as a USB device so that it can be programmed by a modified version of the Arduino IDE. The OLIMEXINO-85 runs the "micronucleus tiny85" bootloader, an open source project written by Bluebie: https://github.com/Bluebie. The bootloader is used by the Digispark board – the board that inspired OLIMEXINO-85. Note that currently OLIMEXINO-85 uses the VID/PID pair that Digistump donated to the community.

For complete instructions on how to use please visit
http://digistump.com/wiki/digispark/tutorials/connecting.

Digispark have bundled the open source Arduino IDE (v1.04) with their Digispark add-ons to make it easy to get started.

Download Digispark's Arduino IDE from the links provided at the web page and remember to install the drivers as explained in the same tutorial article.

There are also good instructions on how to select the proper board so you can upload programs. It is important that due to the small size of OLIMEXINO-85 it has a specific set of settings and a special algorithm of uploading.
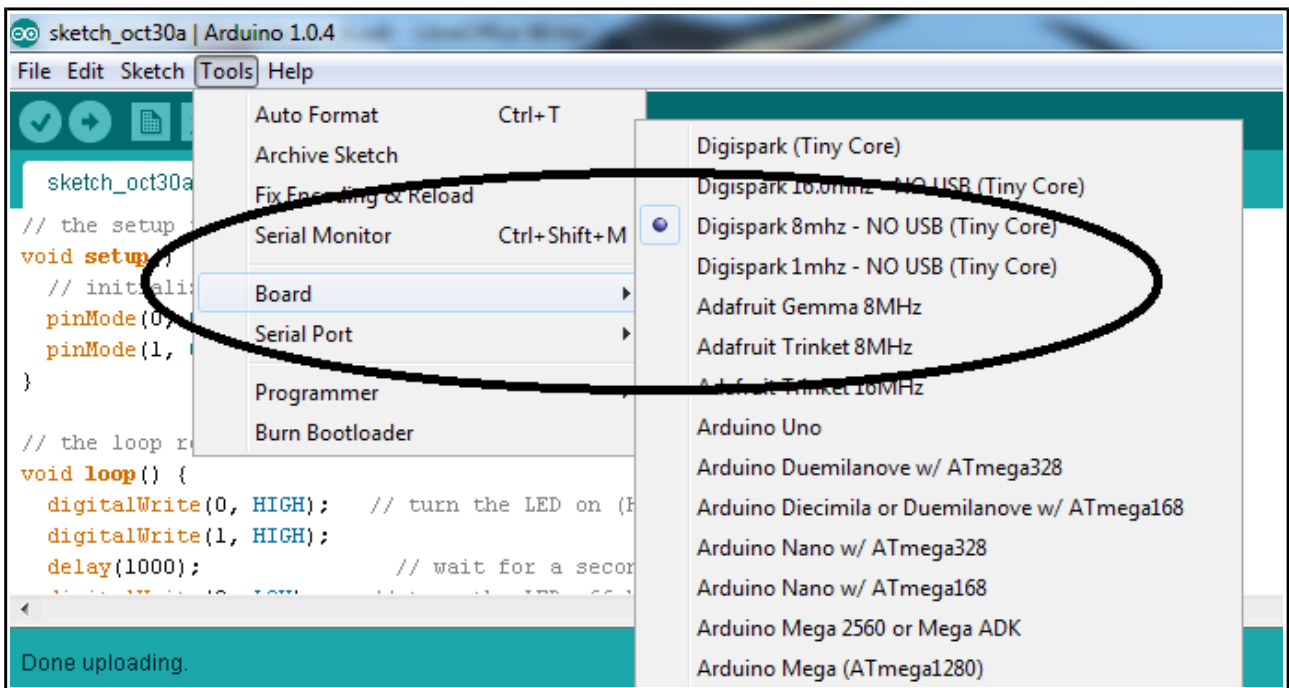
OLIMEXINO-85 is recognized as "Digispark 8mhz - NO USB (Tiny Core)" under "Tools → board"
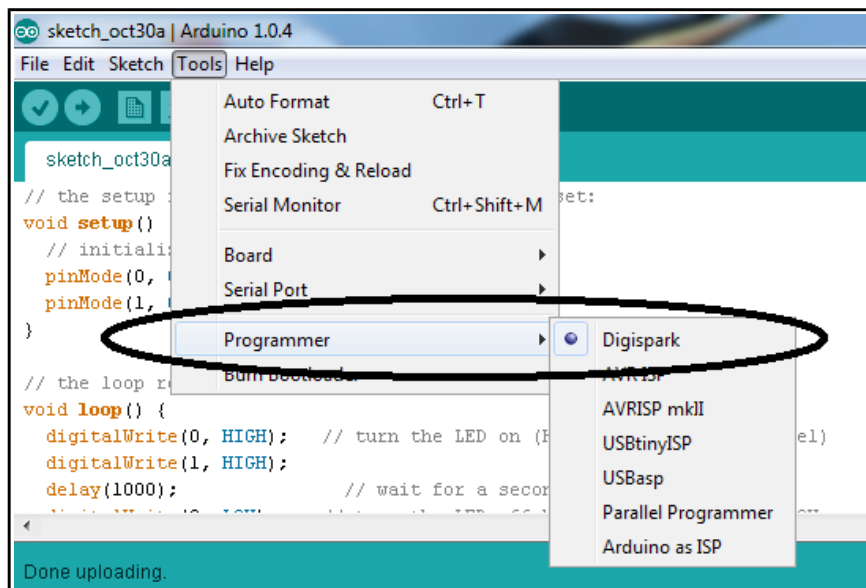
You should also set the "Tools → Programmer" to "Digispark".

When you have a program ready to upload you need to disconnect the board from the mini USB! Then press the upload button in the Arduino IDE interface and you will be asked to connect the board in the next 60 seconds. After you connect the OLIMEXINO-85 don't press anything and just wait until the code is uploaded!

2.5 Examples and libraries tested by OLIMEX

There are number of examples that show different applications of OLIMEXINO-85. They might be downloaded from the software section of the OLIMEXINO-85's own web-page here:
https://www.olimex.com/Products/Duino/AVR/OLIMEXINO-85-ASM.

2.6 Reprogramming the ATtiny85

During your work you might accidentally delete the bootloader on the microcontroller or even worse – you might burn the ATtiny85 microcontroller.

In both cases you would need to download the default bootloader to ATtiny85 to be able to connect and program via the Digispark's Arduino.

Since the OLIMEXINO-85 lacks the required interface you would need jumper wires or your own external socket suitable for the task. You might find a table with correct connections and operations required to do in chapter 4.2 of this user's manual.

The binaries with the bootloader are found in the demo archive that might be downloaded from OLIMEXINO-85's web-page. The hex and elf sources are placed in the "OLIMEXINO-85_firmware" folder.

When you get the files and fix the connections you would need a tool able to upload the bootloader to the ATtiny85 target via your programmer. There are two main software environments used:

1) Use AVR/Atmel Studio or AVRDude to upload respectively the .elf or the .hex to the target ATtiny85.

The .elf file contains the proper fuses and configuration bits. You have to set them manually if you use the .hex file.

Low fuse should be: 0xF1
High fuse should be: 0xD5
Extended fuse should be: 0xFE

2) If you use AVRDude then you need to pass the fuse settings as command line:

lfuse:w:0xF1:m -U hfuse:w:0xD5:m -U efuse:w:0xFE:m

Usually the command to program the board via AVRDude looks like:

avrdude -c stk500v2 -P com26 -p t85 -U flash:w:Olimexino-85_ProductionTest_v_1_0_0.hex -U lfuse:w:0xF1:m -U hfuse:w:0xD5:m -U efuse:w:0xFE:m

,where

stk500v2 is the programmer's interface abbreviation as per AVRdude's documentation
t85 is the abriviation of the name of the target microcontroller as per AVRdude's documentation
Olimexino-85_ProductionTest_v_1_0_0.hex is the name of our binary code.

CHAPTER 3: OLIMEXINO-85 BOARD DESCRIPTION

3. Introduction to the chapter

Here you get acquainted with the main parts of the board. Note the names used on the board might differ from the names used below to describe them. For the actual names check the OLIMEXINO-85-ASM board itself.

3.1 Layout (top view)

The picture below shows top layout of the initial revision of OLIMEXINO-85-ASM.
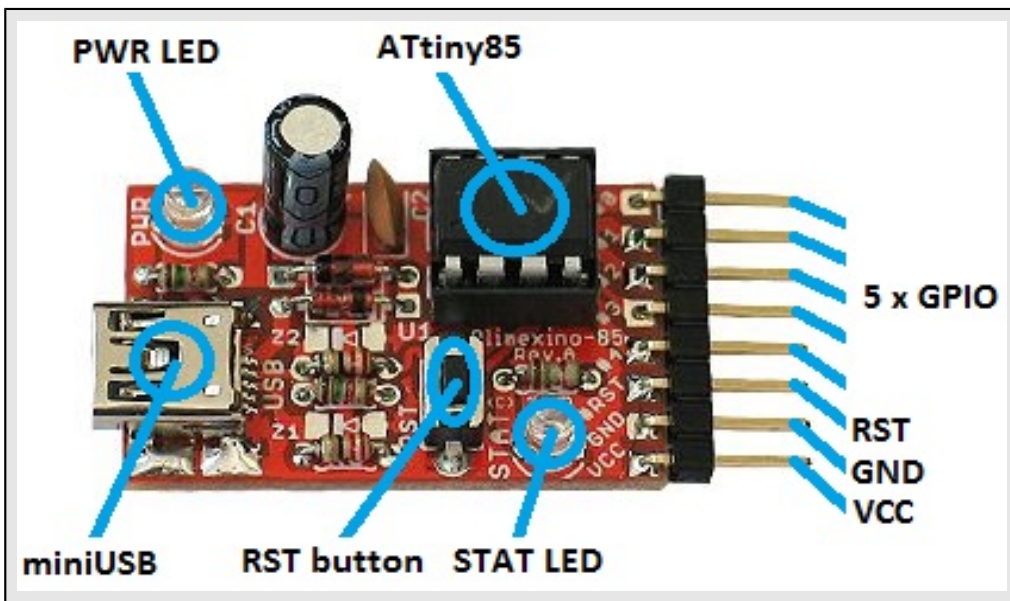
3.2 Layout (bottom view)

The bottom of the board doesn't contain any active or passive elements. It is the place where most soldering is done and you should be careful for the surface you place the board on, to avoid accidental short-circuits.

CHAPTER 4: ATMEL AVR ATTINY85

4. Introduction to the chapter

In this chapter is located the information about the heart of OLIMEXINO-85 – its microcontroller. The information is a modified version of the datasheet provided by its manufacturers.

4.1 The microcontroller

The list of features for ATtiny85 is listed below:

- **High Performance, Low Power AVR® 8-Bit Microcontroller**
- **Advanced RISC Architecture**
    - 120 Powerful Instructions – Most Single Clock Cycle Execution
    - 32 x 8 General Purpose Working Registers
    - Fully Static Operation
- **Non-volatile Program and Data Memories**
    - 2/4/8K Bytes of In-System Programmable Program Memory Flash
        - Endurance: 10,000 Write/Erase Cycles
    - 128/256/512 Bytes In-System Programmable EEPROM
        - Endurance: 100,000 Write/Erase Cycles
    - 128/256/512 Bytes Internal SRAM
    - Programming Lock for Self-Programming Flash Program and EEPROM Data Security
- **Peripheral Features**
    - 8-bit Timer/Counter with Prescaler and Two PWM Channels
    - 8-bit High Speed Timer/Counter with Separate Prescaler
        - 2 High Frequency PWM Outputs with Separate Output Compare Registers
        - Programmable Dead Time Generator
    - USI – Universal Serial Interface with Start Condition Detector
    - 10-bit ADC
        - 4 Single Ended Channels
        - 2 Differential ADC Channel Pairs with Programmable Gain (1x, 20x)
        - Temperature Measurement
    - Programmable Watchdog Timer with Separate On-chip Oscillator
    - On-chip Analog Comparator
- **Special Microcontroller Features**
    - debugWIRE On-chip Debug System
    - In-System Programmable via SPI Port
    - External and Internal Interrupt Sources
    - Low Power Idle, ADC Noise Reduction, and Power-down Modes
    - Enhanced Power-on Reset Circuit
    - Programmable Brown-out Detection Circuit
    - Internal Calibrated Oscillator
- **I/O and Packages**
    - Six Programmable I/O Lines

- 8-pin PDIP, 8-pin SOIC, 20-pad QFN/MLF, and 8-pin TSSOP (only ATtiny45/V)
- **Operating Voltage**
  - 1.8 - 5.5V for ATtiny25V/45V/85V
  - 2.7 - 5.5V for ATtiny25/45/85
- **Speed Grade**
  - ATtiny25V/45V/85V: 0 – 4 MHz @ 1.8 - 5.5V, 0 - 10 MHz @ 2.7 – 5.5V
  - ATtiny25/45/85: 0 – 10 MHz @ 2.7 - 5.5V, 0 - 20 MHz @ 4.5 – 5.5V
- **Industrial Temperature Range**
- **Low Power Consumption**
  - Active Mode:
    - 1 MHz, 1.8V: 300 µA
  - Power-down Mode:
    - 0.1 µA at 1.8V

More information can be found at Atmel's web site at the following web-address:
http://www.atmel.com/Images/Atmel-2586-AVR-8-bit-Microcontroller-ATtiny25-ATtiny45-ATtiny85_Datasheet.pdf

## 4.2 Serial programming of the microcontroller

The table below details the proper connections needed to establish between ICSP programmer and the board's microcontroller (ATtiny85) or to the GPIO connector (e.g. you don't need to remove the microcontroller from its plastic socket, you can lead the proper signals to the GPIO connector of ATtiny85).

To establish the connection below you would need at least 6 jumper wires (male-female). If you connect the ICSP programmer tool to the GPIOs ignore the "TINY85" column in the table. If you connect the ICSP programmer tool to the TINY85 directly (or via a socket) ignore the "GPIO connector name" column.

Cable connection		
6-pin ICSP	**TINY85**	**GPIO connector name**
1	**6**	1
2	**8**	VCC
3	**7**	2
4	**5**	0
5	**1**	RST
6	**4**	GND

How to determine first pin of the above connectors and interfaces – the ICSP programmer should have a mark on the connector for its first pin (or the cable leading to the connector would have a different color on the side of first pin); the TINY85 has a dot that shows which pin is the first one; the GPIO connector has the names of the pins printed on the top of the board.

If your AVR programmer has only 10-pin ICSP you can convert it to 6-pin ICSP following the schematic below:
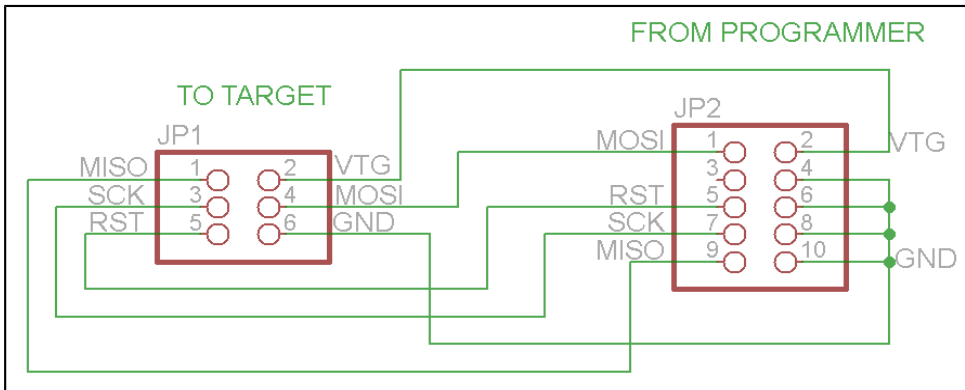
CHAPTER 5: CONNECTORS AND PINOUT

5. Introduction to the chapter

In this chapter are presented the connectors that can be found on the board all together with their pinout and notes about them. Jumpers functions are described. Notes and info on specific peripherals are presented. Notes regarding the interfaces are given.

5.1 USB connector

The USB is usually used to establish connection with the Digispark Arduino IDE. The user's code is transferred to the board via the USB.

Note that the connection to the IDE is possible only a few seconds after powering the OLIMEXINO-85. This is because the bootloader code that establishes the connection is active for a short period of time – after that period the board starts executing user's code.

This means you would need to power down the board every-time before code upload.

The data lines D- and D+ are multiplexed with signals named "3" and "4" of the GPIO connector. This means you can use 3 an 4 in your code which executes after the bootloader phase. If you have USB cable plugged GPIO pins with names "3" and "4" will not work properly.

USB connector		
Pin #	Signal name	Processor pin
1	POWER	-
2	D-	2
3	D+	3
4	-	-
5	GND	-

The connector case is also grounded.

5.2 GPIO connector

The 8-pin GPIO connector is used to interface additional interfaces with the OLIMEXINO-85. You can use it to connect buttons, LEDs and additional components. You can use it to control I2C devices and more.

The connector can provide power and also can be used TO POWER the OLIMEXINO-85. There are 3 GPIOs which are always available and 2 GPIOs that become available when the USB is not in use.

GPIO-1 connector		
Pin #	Signal name	Processor pin
1	0	5
2	1	6
3	2	7
4	3	2
5	4	3
6	#RST	1
7	GND	4
8	VCC	8

5.3 Jumper description

The board has no hardware jumpers.

5.4 Additional hardware components

The components below are mounted on OLIMEXINO-85 but are not discussed above. They are listed here for completeness:

Reset button – used to reset the board

PWR LED – green LED that turns on upon powering the board

STAT LED – programmable general-purpose red LED

CHAPTER 6: SCHEMATICS

6. Introduction to the chapter

In this chapter is located information about the schematics describing logically and physically OLIMEXINO-85.

6.1 Eagle schematic

Search-able OLIMEXINO-85 schematics and sources may be found at the device's web page at our web-site: https://www.olimex.com/Products/Duino/AVR/OLIMEXINO-85-ASM/. An image of the schematic might be found on the next manual page for quicker reference.

Our design software of choice is usually Eagle by Cad Soft version 4.16r2. However, the files should be compatible with the latest Eagle available. Cad Soft offers a trial version of their software that allows you to inspect schematics and board files (without being able to modify them).
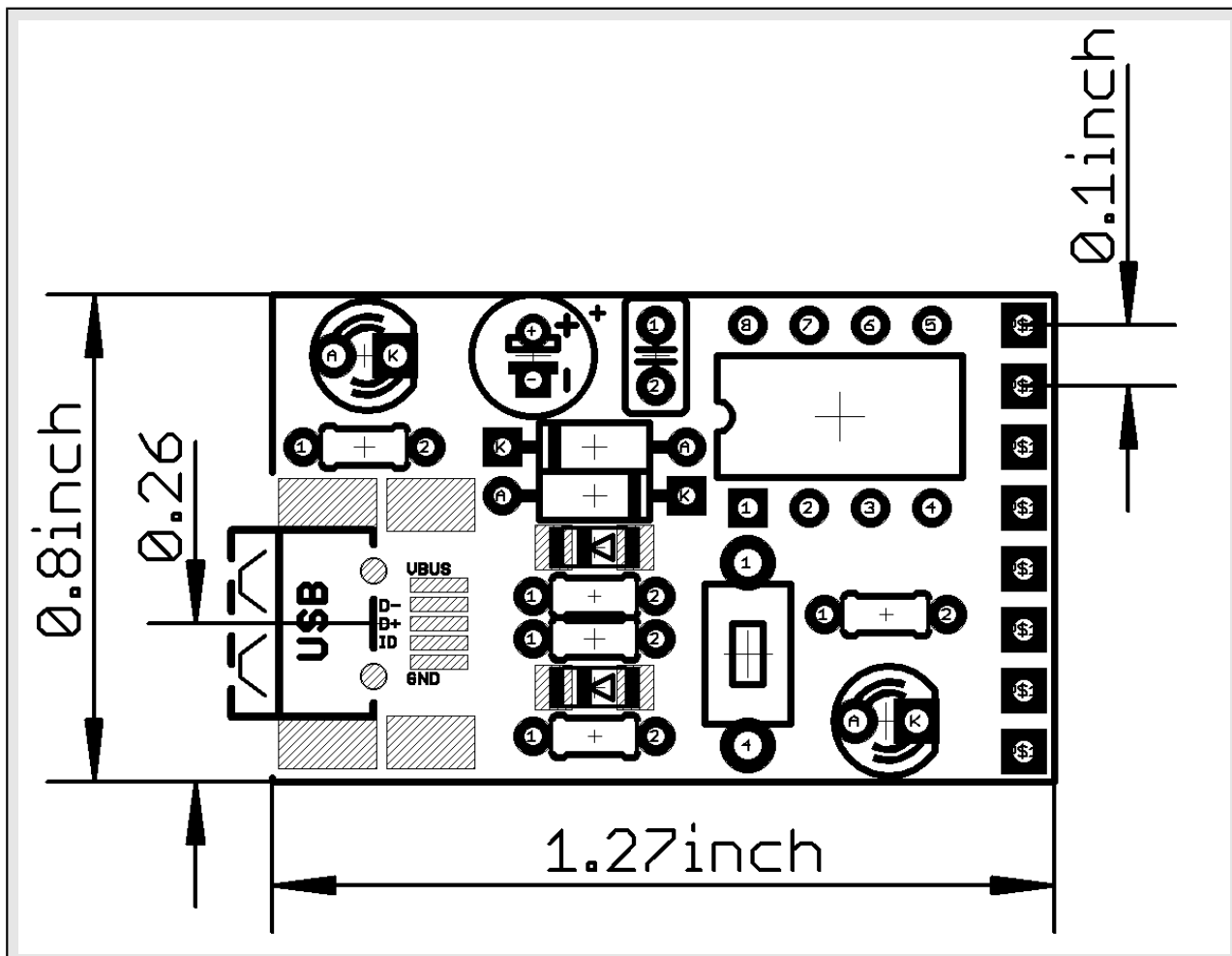
This work is licensed under the Creative Commons Attribution-ShareAlike 3.0 Unported License. To view a copy of this license, visit http://creativecommons.org/licenses/by-sa/3.0/.

If you are looking for a schematic of an older revision of the board and it isn't available at our web site you may request it by the support e-mail.

OLIMEXINO-85, board revision B
OLIMEX LTD, BULGARIA, PLOVIDV 2014
https://www.olimex.com
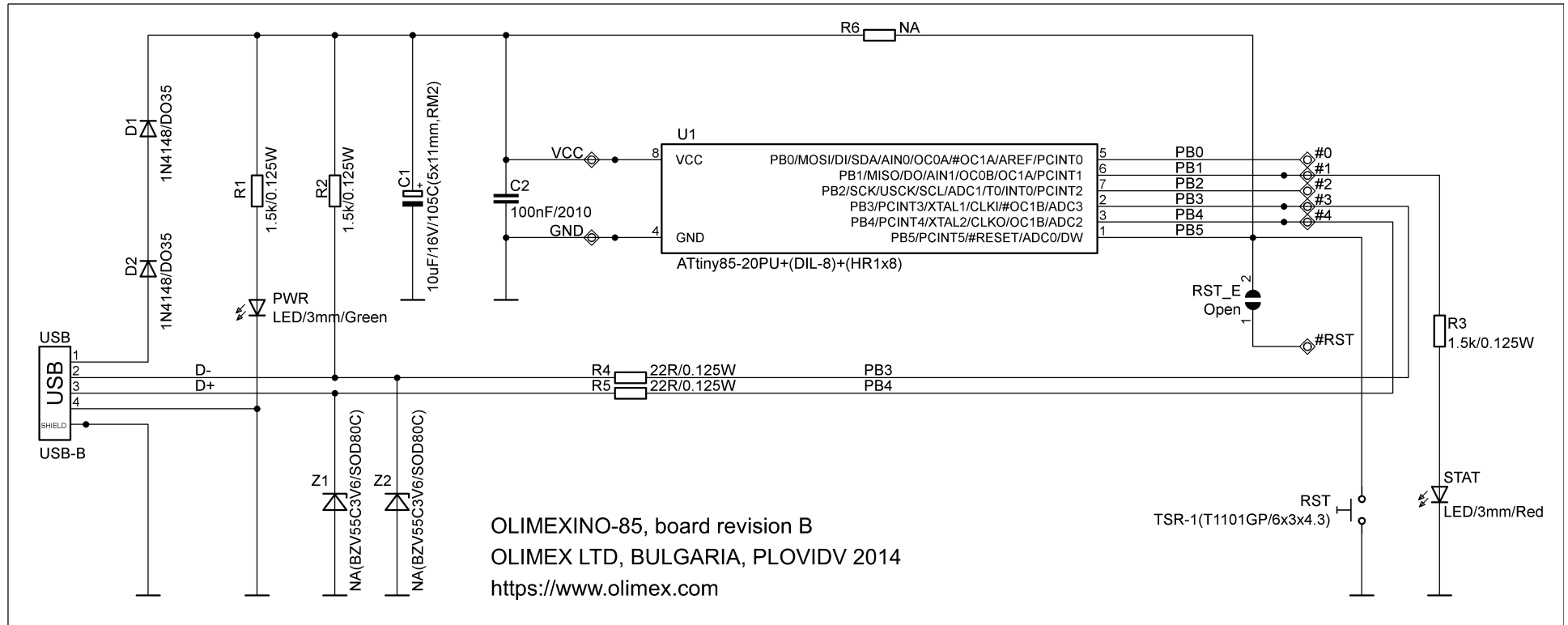
6.2 Physical dimensions

Note that all dimensions are in inches.

The highest element on the board is capacitor C1 with 0.5 inches of height (includes the PCB height).

CHAPTER 7: REVISION HISTORY AND SUPPORT

7. Introduction to the chapter

In this chapter you will find the current and the previous version of the document you are reading. Also the web-page for your device is listed. Be sure to check it after a purchase for the latest available updates and examples.

7.1 Document revision

Revision, date	Changes	Modified page
A, 27.11.13	Initial manual release	All
B, 31.01.14	Adjusted manual to fit the changes of the USB connector	Multiple

7.2 Board revision

Remember to check the schematics and the board design files to compare the differences.

Revision	Notable changes
A	Initial release of the board
B	1 USB mini connector was changed to USB type B 2 Added RST_E jumper (in open position by default) instead of removing the RST pin from the extension. 3 R6(NA) pads are now added to the RST line just in case a resistor is needed

7.3 Useful web links and purchase codes

The web pages you can visit for more information about your device are:
https://www.olimex.com/Products/Duino/AVR/OLIMEXINO-85-ASM/;
https://www.olimex.com/Products/Duino/AVR/OLIMEXINO-85-KIT/.

A place for general questions, FAQ or friendly talk: https://www.olimex.com/forum/.
You may may join our IRC channel #olimex @ freenode.net (http://webchat.freenode.net/?channels=olimex).

ORDER CODES:

OLIMEXINO-85-ASM – the assembled version of OLIMEXINO-85
OLIMEXINO-85-KIT – the kit version of OLIMEXINO-85, you would need to first solder it together to be able to use it

USB-A-B-CABLE for latest board batches; USB-MINI-CABLE for board revision A – standard cables to attach the board to a personal computer

How to purchase?

You can purchase directly from our online shop or from any of our distributors. Note that usually it is faster and cheaper to purchase Olimex products from our distributors. List of confirmed Olimex LTD distributors and resellers: https://www.olimex.com/Distributors.

Please visit https://www.olimex.com/ for more info.

7.4 Product support

For product support, hardware information and error reports mail to: support@olimex.com. All document or hardware feedback is welcome. Note that we are primarily a hardware company and our software support is limited. Please consider reading the paragraph below about the warranty of Olimex products.

```
All goods are checked before they are sent out. In the unlikely event that goods are faulty,
they must be returned, to OLIMEX at the address listed on your order invoice.
OLIMEX will not accept goods that have clearly been used more than the amount needed to
evaluate their functionality.

If the goods are found to be in working condition, and the lack of functionality is a result of
lack of knowledge on the customers part, no refund will be made, but the goods will be returned
to the user at their expense.

All returns must be authorized by an RMA Number. Email support@olimex.com for authorization
number before shipping back any merchandise. Please include your name, phone number and order
number in your email request.

Returns for any unaffected development board, programmer, tools, and cables permitted within 7
days from the date of receipt of merchandise. After such time, all sales are considered final.

Returns of incorrect ordered items are allowed subject to a 10% restocking fee. What is
unaffected? If you hooked it to power, you affected it. To be clear, this includes items that
have been soldered to, or have had their firmware changed. Because of the nature of the
products we deal with (prototyping electronic tools) we cannot allow returns of items that have
been programmed, powered up, or otherwise changed post shipment from our warehouse.

All returned merchandise must be in its original mint and clean condition. Returns on damaged,
scratched, programmed, burnt, or otherwise 'played with' merchandise will not be accepted.

All returns must include all the factory accessories which come with the item. This includes
any In-Circuit-Serial-Programming cables, anti-static packing, boxes, etc.

With your return, enclose your PO#. Also include a brief letter of explanation of why the
merchandise is being returned and state your request for either a refund or an exchange.
Include the authorization number on this letter, and on the outside of the shipping box.

Please note: It is your responsibility to ensure that returned goods reach us. Please use a
reliable form of shipping. If we do not receive your package we will not be held liable.

Shipping and handling charges are not refundable. We are not responsible for any shipping
charges of merchandise being returned to us or returning working items to you.
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The full text might be found at https://www.olimex.com/wiki/GTC#Warranty for future reference.